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LIFE-HISTORIES OF INDIAN INSECTS MICROLEPIDOPTERA

III. GELECHIADÆ

BY

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Imperial Entomologist

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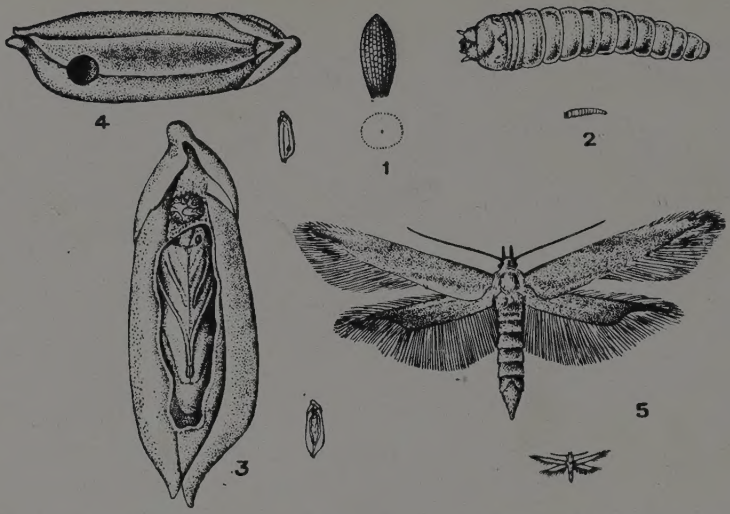

Fig. 1. *Sitotroga cerealella*:—1, Egg ; 2, larva ; 3, pupa inside grain ; 4 attacked grain after emergence of moth ; 5, moth ; all natural sizes and magnified.

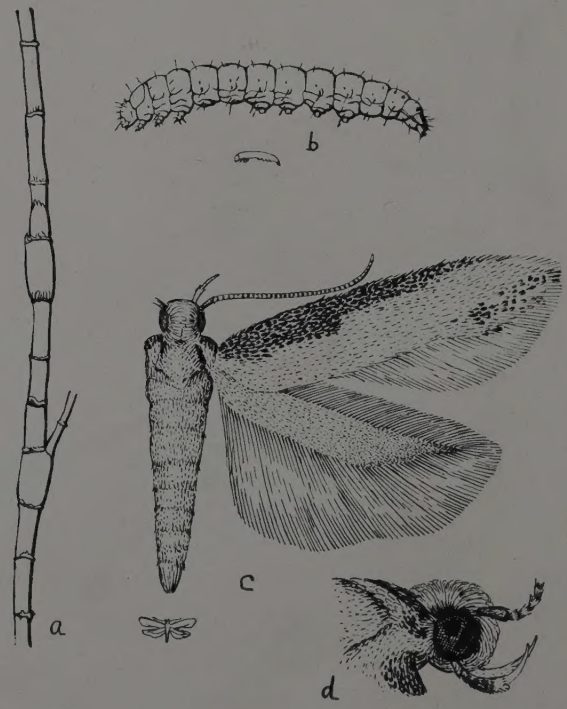

Fig. 2. *Aristotelia ingravata*:—*a*, Tamarix twig bored by larva, showing two galls ; *b*, larva (x 7) ; *c*, moth (x 13) ; *d*, head of moth, from side, more highly magnified.

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III. GELECHIADÆ.

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SITOTROGA CEREALELLA, OLIV. (PLATE XVI, FIG. 1.)

Alucita cerealella, Oliv., Enc. Meth., IV (Ins. I.), 121 (1789)(1).

Sitotroga cerealella, Wlsm., P. Z. S., 1907, 928 (1908) [synonymy](2); Fletcher, S. Ind. Ins., p. 456, f. 331 (1914)(3), Entl. Note 79 (1916)(4).

A cosmopolitan species, the larva found on grain of all kinds; known from N. America, S. Africa, Australia, Europe, India, Ceylon and Japan. It occurs commonly throughout India, Burma and Ceylon and we have it from a number of localities ranging from Peshawar to Coimbatore and Mandalay. North Indian specimens are much larger than those from South India but otherwise there seems to be no difference.

The larva feeds on stored grain (rice, maize, etc.), and is always a minor and sporadically a major pest. Mr. Beeson has also reared this species from bamboo seeds. The whole larval life is passed inside the grain, a single grain sufficing for each larva. Breeding goes on throughout the year except when the temperature is low, the life-cycle taking about four weeks as a rule, but it may last for only three weeks or it may extend up to six weeks, the egg stage lasting for about six days and the pupal for about eight days.

In the case of paddy grain, the egg is always placed inside the scale enveloping one end of the unhusked grain, and from one to five eggs may be packed into this space. Rarely eggs are laid exposed on the grain. Sometimes also many eggs are laid in a cluster hidden in the midst of the grains. Eggs may be laid in the daytime as well as at night.

The egg is about 0·5 mm. long and 0·26 mm. broad, cylindrical, rather stout, translucent white with longitudinal ridges and furrows; the micropylar area, at one end, is flattened and contains a slight circular concavity; the other end of the egg is rounded or slightly tapering. Within a day of deposition the colour of the egg changes to yellowish and it continues to deepen until it is almost brown. The larva emerges by eating through the concave portion of the micropylar area; some larvæ eat a little more of the egg-shell, but only so much of the shell is eaten as is necessary for the emergence of the larva. The empty egg-shell is white. As many as 117 eggs were laid by one female moth between 25th July and 31st July, the moth dying on 3rd August.

The newly-hatched larva is less than 1 mm. long, cylindrical, pinkish-yellow; head brown; five pairs of equally developed prolegs. It seldom bores into the grain on which the egg was deposited but wanders about and selects a grain into which it begins to bore by making a hole in the cavity left by the breaking away of the stalk. After boring a little way into one grain it may leave it and wander about again in search of another. When once it has really entered into a grain, however, it does not leave it again but passes the rest of its larval life in that grain. There is never more than one larva in one grain, at least in the case of rice. Before it has finally settled down, the larva is very quick in its movements, but when grown larger it can hardly walk and seems to be helpless if removed from the grain, nor can it bore into another grain. The larva makes its way directly into the starchy part of the grain and the germ is left untouched. By the time that the larva is full-grown the whole of the starchy portion (of a rice grain) has been consumed.

The full-grown larva is about 6 mm. long and about 1 mm. broad, body very soft with the segments fairly distinct, pure white, with scattered minute white hairs; head smaller than prothorax, into which it is at times retracted pale yellow, mouthparts brown; prothoracic shield large, pale yellow; spiracles round, rimmed with yellow; five pairs of reduced prolegs.

Pupation takes place inside the grain in which the larva has fed. The pellets of frass are pushed to one side and there is formed a white silken cocoon lining almost the whole length of the cavity formed by the larva. The end of the cocoon next the capital extremity of the pupa is left open and the hard covering of the grain at this part is eaten just so much as to leave a thin membranous cover for the open mouth of the cocoon. This cover is broken through by the moth on its emergence.

The pupa is about 5 mm. long and about 1·25 mm. broad, yellow-brown Thin hairs are present on the posterior abdominal segments and cremastral hairs on the anal segment. The last larval skin is pushed to the posterior end

of the cocoon and the cremastral hairs are not entangled in the fibres of the cocoon, although the pupa-case is left inside the cocoon on emergence of the moth.

Eggs laid on 21st hatched on 27th July 1909, and moths emerged from these larvæ between 18th August and 4th September. During cold weather the emergence of the moths is suspended until warmer conditions return. In the case of a quantity of affected paddy grains kept at Pusa, the number of moths emerging became less and less as winter set in until the last moth emerged on 22nd December; no more appeared until 16th January, when one moth emerged, followed by one moth on 10th February, and three on 14th February; after that, the weather became warmer and many moths began to emerge. (Pusa Insectary Cage-slip 771.)

TELPHUSA MELANOZONA, MEYR.

Telphusa melanozona, Meyr., Exot. Micr., I, 65 (1913)(1).

Reared at Pusa in August from larvæ mining leaves of *Euphorbia eriifolia* (1).

Larvæ were collected at Pusa on 15th August 1910, mining leaves of *sij* (*Euphorbia nivulia*). The larva mines the leaf, only a portion of which is sufficient to supply food for its whole larval life. A portion near the apex or about the middle of the leaf is attacked, the larva mining from the margin inwards, the attacked portion withering and turning brown.

The larva is about 10 mm. long and about 1 mm. broad, cylindrical, yellow, soft-bodied, with short scattered hairs; head rather darker.

Pupation takes place usually inside the mine, the larva first preparing for the exit of the moth by making a small hole whose opening is closed by a thin membrane, and then lining the pupal chamber with a very thin layer of silk. The pupa is yellow-brown, the anal segment with a few small cremastral hairs which retain the pupa-case inside the cocoon on emergence of the moth. Occasionally the larva pupates outside of the mine on a leaf, and in such cases it forms a cocoon composed of silk and chewed-up pieces from the epidermis of the leaf. The pupal period is about six days in August. (Pusa Insectary Cage-slip 855.)

ARISTOTELIA INGRAVATA, MEYR. (PLATE XVI, FIG. 2.)

Aristotelia ingravata, Meyr., Exot. Micr., II, 118–119 (1918)(1).

Bred at Pusa from larva forming galls in twigs of *Tamarix gallica*. Also recorded from Peshawar.

The larva bores into a *Tamarix* stem, which swells up a little at the part bored, forming a sort of a gall inside which the larva is found. The larva

does not bore up and down inside the stem but lives in the gall, several of which may be found on the same stem at quite short distances apart (Plate XVI, figure 2*a*).

The larva is about 8 mm. long, cylindrical, slightly tapering towards either extremity, brownish-yellow, prothorax and anal segment tinged with pinkish; head black, shiny; prothoracic shield large, black, shiny; last two abdominal segments with black plates; five pairs of short prolegs.

Pupation takes place inside the gall, through one end of which the larva gnaws a round hole for emergence of the moth, this hole being stopped with a thin layer of silk, which is burst by the moth. The larva may pass the summer in a resting condition inside the gall. From larvæ collected on 15th February 1915, one moth emerged on 23rd April and another moth on 22nd October whilst larvæ were still living in the galls on 29th September 1915. Moths have also been reared out in May. The larvæ are extensively parasitized. (Pusa Insectary Cage-slip 1202.)

IDIOPHANTIS CHIRIDOTA, MEYR.

Idiophantis chiridota, Meyr., Exot. Micr., I, 201 (1914)(1).

Reared at Peradeniya in May from galls produced by a Psyllid on *Eugenia*(1).

ISTRIANIS CRAUROPA, MEYR.

Istrianis crauropa, Meyr., Exot. Micr., II, 130 (1918)(1).

"Bred at Dharwar, N. Kanara, in June from a larva feeding externally on lower surface of leaf of *Butea frondosa* (Leguminosæ) in May (*Maxwell*); pupa in spindle-shaped cocoon on leaf(1)."

EPHYSTERIS CHERSÆA, MEYR.

Ephysteris chersæa, Meyr., P. Z. S., 1908, 725(1), Exot. Micr., II, 131 (1918)(2).
Epithectis oschophora, Meyr., Rec. Ind. Mus., V, 219-220(3); Fletcher, Entl. Note 80 (1916)(4).

First described from the Transvaal(1) and afterwards from Maskeliya, Diyatalawa, Calcutta and Purneah(3), this species has since been recorded from the Tenimber Islands, New Guinea(2). We have it from Purneah, Coimbatore and Abbottabad.

The larva is stated to feed in dry vegetable refuse(2). The moth was reared at Coimbatore in 1914, from *cholam* stubble(4).

EPITHECTIS STUDIOSA, MEYR.

Epithectis studiosa, Meyr., B. J., XVI, 591–592 (1905)(1).

Described from Peradeniya, where the larva was found feeding on dried plants in the herbarium(1). The Peradeniya collection also contains specimens under this name reared from rice received from Northern India.

PHTHORIMÆA HELIOPA, LOWER.

Gelechia heliopa, Lower, P. Linn. Soc. N. S. W., 1900, 417(1).

Gnorimoschema heliopa, Meyr., P. Linn. Soc. N. S. W., 1904, 320–321(2), B. J., XVI, 592 (1905)(3); Lefroy, Ind. Ins. Pests, p. 156(4), Ent. Mem. Agr. Dept. Ind., I, 224(5), Ind. Ins. Life, pp. 534-535(6), Agr. Jl. Ind., III, tab.(7); Fletcher, S. Ind. Ins., pp. 454-455, t. 43 (1914)(8).

Phthorimæa heliopa, Fletcher, Entl. Note 81 (1916)(9), Proc. Second Entl. Meeting, p. 272 (1917)(10).

Originally described from Australia(1) this species is widely distributed in India and Ceylon, and probably occurs in Java also. It occurs throughout the Plains of India, Burma and Ceylon, but we have no records from North-Western India. Our records are from Hanguranketa (Ceylon), Coimbatore, Shevaroy Hills, Hagari, Penukonda (Anantapur District), Tharsa, Gujarat, Nadiad, Anand District, Pusa, Rangpur and Zigonkwin (Burma). In most districts this seems to be a minor pest of tobacco, the larva boring into the stem and causing a characteristic gall-like swelling, but it is sporadically serious and in Western India it is a major pest of tobacco.

The egg is elongate-oval, about 0·5 mm. long, greenish at first, changing later to orange-yellow. The eggs are laid at night indiscriminately anywhere on the plant but especially on the lower surfaces of the leaves. In confinement one female laid 58 eggs during one night, dying next day. The egg hatches after about 19 days in December or 11 days in March.

The newly-hatched larva is about 1 mm. long, cylindrical, translucent yellowish-white; head large, black; prothoracic shield small, black; a few hairs scattered over segments; five pairs of prolegs. It emerges from the egg by gnawing a hole at one end but the egg-shell is more or less burst open longitudinally. The empty egg-shell is not eaten by the young larva. As it grows the yellow tinge is gradually lost and the full-grown larva is about 10 mm. long, cylindrical, tapering slightly posteriorly, segments fairly distinct, translucent whitish or greyish; head smaller than prothorax, dark-brown; prothoracic shield large, black, divided medially; fifth abdominal segment with a brownish patch; spiracles round, rimmed with black; five pairs of prolegs.

The young larva bores into the tissue of a tobacco leaf, usually near the place where it has emerged from the egg, in cases where the egg was laid on a leaf, and mines into the leaf. If the egg was laid on a stem, the young larva bores directly into the stem. The mine in the leaf is not large as the larva, as soon as it comes across a vein, bores into that until it reaches the midrib of the leaf, leaving a trail of black pellets of excrement behind it. The larva may take about a week to reach the midrib, the time depending on the distance it has to travel. In the case of young plants with hardly any stem the larva may remain in the midrib and pupate there ; but, when there is a stem, the larva bores into that through the midrib. In either case, whether in midrib or stem, the feeding of the larva produces a gall-like swelling which is a characteristic sign of attack. This swelling is not immediately evident but appears two or three weeks (in the cold weather) after the larva has reached the midrib. More than one larva may be present in one stem and thus slitting of the stems, as sometimes practised, does not ensure removal of all the larvæ.

Pupation takes place in the larval tunnel in the stem or midrib. Prior to pupation the larva prepares a hole of exit for the moth, the mouth of the hole being covered with a thin white silken webbing. The larva next prepares a thin brownish silken cocoon lining the tunnel and pupates in this. The pupa is about 6 to 7 mm. long, cylindrical, tapering posteriorly, brown, anal segment with small grey cremastral hooks. The empty pupa-case remains inside the cocoon.

The moth is active only at night and passes the day resting motionless on the plants or any suitable object. The moths live in confinement for six to twelve days.

The following table shows the life-cycle during the winter but in the warm weather the period is much shortened :—

Eggs laid	Eggs hatched	Larvæ pupated	Moth's emergence	Duration days
6–XII	20–XII	9–II	9–III	93
6–XII	20–XII	4–III	31–III	115
8–XII	21–XII	3–II	5–III	87
10–XII	23–XII	2–III	20–III	100
18–XII	6–I	..	30–III	102
18–XII	6–I	..	2–IV	105
22–XII	10–I	..	26–III	94
22–XII	10–I	..	5–IV	104

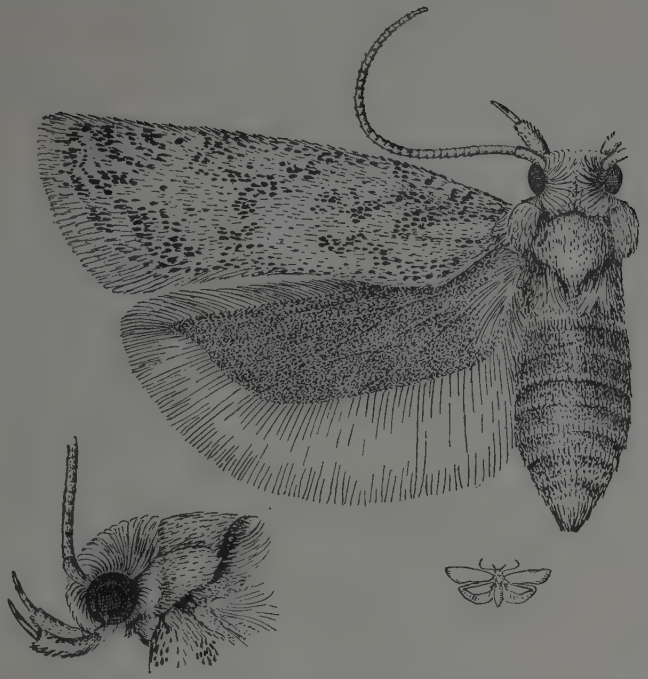

Fig. 1. *Phthorimaca blapsigona*:—Moth, natural size and magnified. Below is seen a more highly magnified view of the head, as seen from the side.

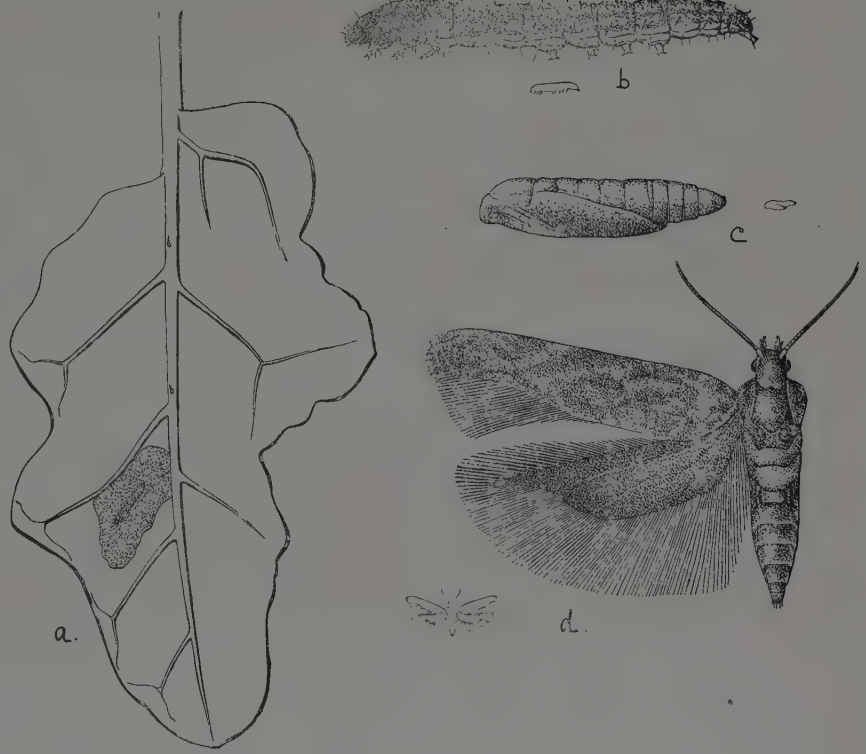

Fig. 2. *Phthorimaea ergasima*:—*a*, Brinjal leaf with larval mine; *b*, larva; *c*, pupa ; *d*, moth ; natural sizes and magnified (x 8).

PLATE XVII.

PHTHORIMÆA OPERCULELLA.

Entl. Meeting, p. 2

Described from specimens reared at [illegible] July and August from larvæ feeding on buds of [illegible]

This species has been reared at [illegible] and Nagpur from larvæ boring and feeding in flower-buds of [illegible] also reported into the fruits at Nagpur, and is stated to be a definite pest in Madras Central Provinces. We have not been able to find this [illegible] have no details of its early [illegible]

EXPLANATION OF PLATE XVIII.

PHTHORIMAEA OPERCULELLA.

Fig. 1. A potato plant showing injury caused by the larvæ.
„ 2. Moth resting on plant.
„ 3. Potato tuber showing evidences of caterpillar attack in the masses of excrement at the eyes. A cocoon on the tuber.
„ 4. Potato tuber cut open to show damage caused by caterpillar.
„ 5. Potato tuber showing the track of the caterpillar and the pupa.
„ 6. Young larva.
„ 7. Imago, male.
„ 8. „ female.
„ 9. [illegible]
„ 10. Pupa.
„ 11. Adult larva.
„ 12. Eggs deposited at the eye of a potato tuber, magnified [illegible] and (The hair-lines show the natural sizes.)

[illegible] been found at Dharwar on one occasion only as [illegible] leaves (Entom [illegible] to [illegible] [illegible] Coimbatore, Chingleput, Guntur, Nellore, Anantapur, Bellary, Cuddapah, Kurnool, Trichinopoly, Tanjore, Madura, Ramnad, Tinnevelly, Salem, North Arcot, South Arcot, Chittoor, Nilgiris, Malabar, South Canara, Vizagapatam, Godavari, Kistna

EXPLANATION OF PLATE XVIII.

PHTHORIMAEA OPERCULELLA.

Fig. 1. A potato plant showing injury caused by the larvæ.

" 2. Moth resting on plant.

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" 4. Potato tuber cut open to show damage caused by caterpillar.

" 5. Potato tuber showing the track of the caterpillar and the pupa.

" 6. Young larva.

" 7. Imago, male.

" 8. " female.

" 9.

" 10. Pupa.

" 11. Adult larva.

" 12. Eggs deposited at the eye of a potato tuber, magnified.

(The hair-lines show the natural sizes.)

PHTHORIMÆA BLAPSIGONA, MEYR. (PLATE XVII, FIG. 1.)

Phthorimœa blapsigona, Meyr., Exot. Micr., I, 569 (May 1916) (1) ; Proc. Second Entl. Meeting, p. 288 (1917)(2).

Described from specimens reared at Coimbatore in July and August from larvæ feeding on buds of *brinjal* (*Solanum melongena*)(1).

This species has been reared at Coimbatore, Saidapet and Nagpur from larvæ boring and feeding in flower-buds of brinjal. It is also reported to bore into the fruits at Nagpur, and is stated to be a decided pest in Madras and the Central Provinces. We have not been able to find this species at Pusa and have no details of its early stages.

PHTHORIMÆA OPERCULELLA, Z. (PLATE XVIII.)

Gelechia operculella, Zeller, Verh. ZB. Ges. Wien., XXIII, 262-263, t. 3, f. 17 (1873)(1).

Phthorimœa operculella, Wlsm., P. Z. S., 1907, 942 [synonymy](2) ; Meyr., T. L. S. (2) XIV, 273 (1911) (3) ; Lefroy, Ind. Ins.Life, p. 535, t. 57 (1909)(4), Agr. Jl. Ind., V, 19-28, t. 1 (Jan. 1910) (5) ; Fletcher, S. Ind. Ins., p. 455, t. 44 (1914)(6) ; Proc. Second Entl. Meeting, pp. 286, 288 (1917)(7).

This species, which has been carried to almost all parts of the World with potato tubers, was brought into Bombay from Italy probably about twenty years ago, and has now spread into most of the potato-growing districts of India, where it is a very important pest of the stored tubers. It has also been found at Dharwar on one occasion mining brinjal leaves (Entomological Note 77). Our records include Mirpurkhas (Sind), Poona, Dharwar, Nilgiris to 6,500 feet, Coimbatore, Chindwara, Sitamarhi, Partabgarh, Bankipur, Bettiah, Pusa and Purneah, but there is no doubt that this species is still spreading and will ultimately invade all the potato-growing districts in India.

In America and South Africa this species is well-known as a destructive miner in tobacco leaves, but it has not been noted to attack tobacco in India. It has also been noted on tomato, *Solanum torvum*, *S. verbascifolium*, *S. carolinense*, *S. nigrum*, *Physalis peruviana*, *Physalodes physalodes*, and *Datura stramonium*, but has not been recorded on these foodplants in India.

The early stages have been described by Morgan and Crumb (*U. S. A. Dept. Agric. Bull.* 59 ; 1914) as follows :—

" *Egg.* The egg is pale, translucent, yellowish-grey, and strongly iridescent ; it is oval, 0·45 mm. long, 0·35 mm. broad at the middle, membranous, and without apparent sculpture. The side upon which it is deposited is slightly flattened.

"*Larva.* The full-grown larva is 7 to 14 mm. long. The head shield is 0·80 to 0·86 mm. broad and fuscous brown. The cervical shield is darker brownish-fuscous, with a pale mid-dorsal line, shining, the posterior margin medially straight. The anal shield is brown. The mesothorax and metathorax are deep maroon. The body varies in colour through green and grey and is overlaid dorsally with purplish as the larva nears pupation. It is slender, tapering from the mesothorax posteriorly and set closely and uniformly with minute granules each bearing a minute point, the granules of the thorax and the last abdominal segment being the larger. The tubercles and their setæ are inconspicuous, brownish; tubercle II is slightly larger than I. The legs are deep fuscous; the prolegs, green.....The larva on potato is more greyish on the body...and has the mesothorax and metathorax pinkish instead of deep maroon.

"*Pupa.* The pupa is yellowish-brown, 5·5 to 7 mm. long and 1·5 to 2 mm. broad; it is broadest through the metathorax, tapering both anteriorly and posteriorly. The head is rather distinct and slightly nodding. The abdomen, excepting the last three segments, is set with very minute spinules; it bears at the tip mid-dorsally a short, curved, erect, pointed horn flanked by about four pairs of long hooked spinules, and ventrally a pair of blunt, rounded lobes beneath which are about four pairs of long hooked spinules. Each abdominal segment is set with a transverse row of spinules near the anterior margin."

A good deal of work has been done in India to combat the attack of this pest on stored potato tubers, and accounts will be found in the *Agricultural Journal of India* and in the *Bihar Agricultural Journal.* Storage under sand has been found successful in some districts, and in others fumigation with petrol vapour and subsequent storage in moth-proof godowns is used.

PHTHORIMÆA ERGASIMA, MEYR. (PLATE XVII, FIG. 2.)

Phthorimœa ergasima, Meyr., Exot. Micr., I, 568–569 (1916)(1), *l. c.*, II, 135 (1918)(2); Proc. Second Entl. Meeting, p. 288 (1917)(3).

Described from Pusa(1).

"Larva green, head and plate of 2 purplish; mines a blotch in leaves of *Solanum melongena* (Fletcher)"(2).

At Pusa the larvæ mine brinjal leaves in January to March and in July and perhaps throughout the year, eating the tissues between the epidermal layers. The larva is able to emerge from its mine and walk about and enter a leaf again at another place. The mine is usually near the tip of a leaf. The larva is about 7 mm. long and about 1·25 mm. broad across the metathorax

whence it tapers prominently anteriorly and slightly posteriorly, rather flattened, segments distinct, yellowish with reddish dorsal and lateral stripes; head flattened, smaller than prothorax, dark brown, shiny; prothorax smaller than mesothorax, dark brown, with a shiny dark-brown medially-divided plate; mesothorax slightly smaller than metathorax, with reddish markings dorsally; metathorax entirely yellow; five pairs of small, equally developed prolegs. Pupation takes place either inside the mine or under the shelter of a leaf fastened down with silk. The pupal period is about seven days in July and eleven days in February. (Pusa Insectary Cage-slips 952, 1328 and Dwarka Prasad Singh's Cage-slip dated 18th February 1916.)

PHTHORIMÆA OCELLATELLA, BOYD.

Gelechia ocellatella, Boyd., Entom. Weekly Intell., IV, 143 (1858) (1); Stainton, Manual II, 340 (1859)(2); Meyr., Handbk., p. 593 (1895)(3).

Phthorimæa ocellatella, Meyr., Exot. Micr., II, 135 (1918)(4).

This is a European species recorded from Western and Southern Europe, Madeira, Asia Minor and, within our limits, from Galle (Ceylon)(1).

The larva is described by Stainton (2) as "pale greyish-white, with four dull reddish interrupted lines along the back; head pale yellowish-brown. On the flowers of *Beta maritima*."

In Italy this species has recently been recorded by Del Guercio as injurious to beet, feeding on the tender leaves and then tunnelling into the root. (See *Review Appl. Entom.*, Ser. A, Vol. VII, page 193; May 1919.)

STOMOPTERYX NERTERIA, MEYR.

Anacampsis nerteria, Meyr., B. J., XVII, 139 (1906)(1), Rec. Ind. Mus., V, 220 (2), Ann. Transvaal Mus., II, 11 (1909)(3); Lefroy, Ent. Mem., I, 226 (4), Ind. Ins. Life, p. 534(5).

Aproœrema nerteria, Fletcher, South Ind. Ins., pp. 457–458, f. 333 (1914)(6), Proc. Second Entl. Meeting, pp. 43, 47, 92 (1917)(7).

Stomopteryx nerteria, Meyr., Exot. Micr., II, 138 (1918)(8).

Originally described from Maskeliya (Ceylon)(1), this species has since been recorded from India (2) and Pretoria (South Africa)(3). In India it is widely distributed in the Plains. Our records include moths reared at Coimbatore on *Cajanus indicus*, mining and folding the leaves; at Pusa and Nagpur on soybean, on the young leaves and shoots; on groundnut at Peradeniya, Coimbatore, Hagari, Dharwar and Fraserganj (Sundarbans); and on *Psorulea corylifolia* at Pusa and Nagpur. We also have moths from Peshawar and

Mandalay. In Madras it is an important pest of groundnut and is well-known under the name of *surul puchi*.

The whole life-cycle is passed on the foodplant, the egg being laid on the leaves or stems, the larva at first mining into the leaves and later on tying them together, and pupating in the larval shelter so formed.

The egg is described by Green as "pale green, irregularly elongate-oval, surface coarsely pitted in irregular longitudinal series, under the microscope remarkably similar both in form and sculpture to seed of *Arachis*." It has also been recorded by T. V. Ramakrishna Ayyar and Y. Ramachandra Rao as "about 0·35 mm. in length, longer than broad, somewhat flattened, with the proximal face resting flatly on the leaf and the distal one convex. Its external surface is ornamented with a system of ridges forming a kind of network, while its inner face, by which it is attached, is, except for a few obsolete ridges, more or less even. In colour it is creamy yellow when freshly laid; it retains this tinge to a greater or less extent until the third day, when a black dot (the head of the larva) makes its appearance, and as it approaches the time of hatching it gradually turns dark."

The egg may be laid on any part of the upper portion of the foodplant; when laid on a leaf, it is usually placed on the lower surface; as a rule the egg is laid in some slight depression on the plant.

The eggs are laid singly by night, the maximum number laid by one female being noted as 97, and hatch after three days.

The newly-hatched larva is slightly over 0·5 mm. long, dull grey, flattened anteriorly, slender posteriorly; head black; prothoracic shield light brown. It wanders about for a short time and then mines into a leaf, the mine after a day or two showing up as a whitish-brown streak; the interior of the mine is lined with a layer of silk. After mining for about eight days, the larva bites its way out of the mine and webs together two or more leaflets and lives under shelter, forming a small oval silk-lined chamber about 8 mm. long in which the larva lives and ultimately pupates. After another three or four days it is full-grown and is then about 5·5 to 6 mm. long, rather stout, faint dirty green; head, prothoracic and anal shields dark brown; each segment with tubercles from which arise pale brown setæ; legs dark brown; prolegs greenish. Male larvæ show, between the fourth and fifth abdominal segments, a pair of asymmetrically-situated dark violet testes, which are clearly visible through the skin. Pupation takes place in a closely-woven torpedo-shaped cocoon, about 9 mm. long, and usually constructed in the larval chamber to whose sides it is rather loosely attached. The pupa is about 4·5 mm. long, rather stout, yellowish or reddish brown; cephalic and thoracic regions thickly covered

PLATYEDRA GOSSYPIELLA.

with minute velvety hairs; abdominal segments with similar but longer hairs which are, however, confined to a median transverse belt on each segment; anal segment with cremastral hooks which retain the pupa-case within the cocoon on emergence of the moth. The pupal period is about four days.

The moth flies at night, hiding during the daytime in the soil, in crevices or under clods. It is strongly attracted to light at night. The moth has been found to live for sixteen days in confinement; under natural conditions its life is probably much longer.

The life-cycle is about three weeks, of which the egg stage lasts for twelve to fourteen days, and the pupal stage for four days. Under colder conditions, the cycle may be prolonged to six weeks. Under suitable conditions of temperature and presence of foodplants, this insect seems to breed throughout the year and no regular broods can be distinguished.

EXPLANATION OF PLATE XIX.

PLATYEDRA GOSSYPIELLA, SAUNDERS. (Figs. 1–8.)

PLATYEDRA GOSSYPIELLA.

Fig. 1. Eggs, enlarged.
„ 2. Young larva.
„ 3. Adult larva.
„ 4. Pupa.
„ 5. Infested cotton-boll.
„ 6. Larva inside cotton-seed.
„ 7. Moth.
„ 8. (The hair-lines show the natural sizes.)

Depressaria gossypiella, Saunders, T. E. S. [illegible]

Gelechia gossypiella, Meyr., [illegible] 92, (1905)(2); Wilson, Farm. Hawaii, I, 731–733 (1907)(3); [illegible] Ins. Pests, p. 93, ff. 101–103(4); Fletcher, Mem., I, 223, f. 63(5); Adult. larva. Life, p. 531, f. 344 (1909)(6); Fletcher, Bull. Ent. Res., III, 201, fig. (1912)(7); Fletcher, S. and [illegible] p. 151, t. 42 (1914)(8); Wilcocks, [illegible] Vol. I, pt. [illegible] pp. [illegible], 17 figs., 10 tabs. (1918)(9); [illegible] Ent. Bull. 4 (1918)(10); Fletcher, Proc. Second Ent. Meeting, pp. 10, 111–114, 127, 128, 134, (1917)(11).

Pectinophora gossypiella, Busck, [illegible] (1917)(12); Ballou, Journ. Ec. Ent., XI, 236–245 (1918)(13).

Platyedra gossypiella, Meyr., Exot. Mic. II, 38 (1918)(14).

This species, the notorious "Pink Bollworm" of cotton, was first described from Western India(1) and there is little doubt but that India was its original home, whence it has been carried in recent years with cotton seed to most parts of the world, so that it is now very widely distributed and is known to occur in the Straits Settlements, Philippines, Japan (?), Hawaii, Zanzibar, East Africa, Sudan, Egypt, Brazil, Mexico and the Southern United States.

P. gossypiella occurs commonly throughout the Plains of India, Burma and Ceylon and is everywhere a pest of cotton, serious in most localities, especially so in the United Provinces, North-West Frontier Province and Madras. It is especially evident towards the end of the season when a large percentage of the bolls and seeds is attacked. In all districts exotic varieties seem

with minute velvety hairs; abdominal segments with similar but longer hairs which are, however, confined to a median transverse belt on each segment; anal segment with cremastral hooks which retain the pupa-case within the cocoon on emergence of the moth. The pupal period is about four days.

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PLATYEDRA GOSSYPIELLA, SAUNDERS. (PLATE XIX.)

Depressaria gossypiella, Saunders, T. E. S. (1), III, 285 (1842)([1]).

Gelechia gossypiella, Meyr., B. J., XVI, 592, (1905)([2]); Wlsm., Faun. Hawaii, I, 731–733 (1907)([3]); Lefroy, Ind. Ins. Pests, p. 93, ff. 104-106([4]), Ent. Mem., I, 223, f. 69([5]), Ind. Ins. Life, p. 534, f. 344 (1909)([6]); Durrant, Bull. Ent. Res., III, 203–206, fig. (1912)([7]); Fletcher, S. Ind. Ins., p., 454, t. 42 (1914)([8]); Willcocks, Ins. Pests Egypt, Vol. I, pt. i, pp. 1-339, 17 figs., 10 tabs. (1916)([9]); Gough, Egypt Agric. Ent. Bull. 4 (1916)([10]); Fletcher, Proc. Second Entl. Meeting, pp. 10, 111–114, 127, 129, 130, (1917)([11]).

Pectinophora gossypiella, Busck, Journ. Agri. Res., IX, 243-370, t. 7–12 (1917)([2]); Ballou, Journ. Ec. Ent., XI, 236–245 (1918)([13]).

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most liable to attack. The larva bores into the bolls, feeding on the seeds and spoiling the lint, and also does some damage to buds and flowers when bolls are not available, but when bolls are formed these are much preferred. Many of the attacked bolls drop off and there may be considerable loss of crop from this, or the bolls open prematurely and the fibre is short, dirty and comparatively useless. The oil content of the attacked seed is seriously lessened also, and the germination is affected if the seeds are used for sowing. The loss due to this insect in India alone runs to many millions of Rupees annually.

As noted above, the larva is a serious pest of cotton, but has also been found in India breeding on *Hibiscus abelmoschus, Abutilon indicum* and doubtfully on hollyhock. In Egypt and Hawaii it has been bred from *Thespesia populnea* and in Hawaii also from fruits of *Hibiscadelphus hualalaiensis*. In Egypt it has been reared from hollyhock, *Hibiscus esculentus* and *H. cannabinus* and it will probably be found to breed in these foodplants in India also.

Very detailed accounts of the life-history have been given by Willcocks(9) and Busck(12) and reference should be made to their publications for full details. Briefly, the life-history is as follows :—The egg is usually laid on a cotton-boll but may be deposited on a flower or leaf. It hatches in about six days (more or less according to season), and the small yellowish larva, which is very active, either bores into a boll at once, or bores into a flower or nibbles the leaves for a short time before entering a boll. Entered into a boll (or seed-pod, in the case of foodplants other than cotton) it feeds on the seeds, either completely eating out a single seed or nibbling several. It is full-fed after two or three weeks, by which time it is salmon pink and about 12 mm. long, and then emerges from the boll through a circular hole and pupates in a flimsy cocoon usually formed under some shelter on the ground (*e. g.*, under a fallen leaf, flower, clod, etc.). If the lint is picked whilst the larva is still feeding, it emerges when full-fed and may pupate in the lint or in any convenient shelter in the store-room. Rarely pupation takes place inside the boll. In some cases, however, usually towards the end of the season, the larva does not pupate at once, but goes into a resting condition which may last for many months. In the case of larvæ feeding in stored cotton-seed, the larva usually attaches a second seed to the seed in which it is feeding and the presence of these double seeds is a sure sign of infection by this insect. After a variable, but often considerable, interval of time these resting larvæ pupate and emerge as moths. Thus, from larvæ collected at Pusa on 10th November 1907, one larva pupated on 12th March, and emerged on 28th March 1908, whilst another larva of this lot pupated on 4th June and emerged on 13th June 1908. The

following table shows the variation exhibited by larvæ from eggs laid at the same time.

Egg laid	Egg hatched	Larva pupated	Moth emerged
14–X–07	19–X–07	13–XI–07	1–XII–07
17–X–07	23–X–07	12–XI–07	29–XI–07
17–X–07	23–X–07	20–XI–05	9–XII–07
17–X–07	23–X–07	....	30–V–08
18–X–07	24–X–07	14–XI–07	4–XII–07

Some larvæ may, however, enter into a resting stage which lasts for two years or perhaps even longer.

The egg is elongate-oval with rounded ends, about 0·53 mm. long and 0·26 mm. broad, with minute longitudinal (but slightly zigzag) ridges; at first translucent white, looking green against the green background of a leaf or boll, but turning light yellow before hatching, the head of the enclosed larva showing as a large black spot at one end. The young larva does not eat the empty egg-shell.

The newly-hatched larva is about 1 mm. long, cylindrical, tapering posteriorly, yellow; head black, shiny; prothoracic shield dark brown. When about half-grown, it is yellowish-white with pinkish suffusion around the spiracles and tubercles, head chestnut-brown, prothoracic shield brownish. When full-grown it is about 12 mm. long, rather stout, about 2·5 mm. broad, pinkish; head brown; prothorax broad, with a medially divided, light brown shield; all segments (except head and anal segment) with a broad salmon-pink ring broken on each side by two delicate light-grey spots which form an interrupted lateral stripe; anal segment with a small shield; hairs moderate.

The pupa is about 6 to 7 mm. long and about 2·6 mm. broad, yellowish-brown, with short brown hairs densely scattered over the surface; anal segment with a black cremastral spine and numerous shorter hair-like hooklets. These cremastral hooks retain the pupa-case inside the cocoon on emergence of the moth.

The moth flies in the evening, after dusk, remaining during the daytime hidden away under any convenient shelter; when disturbed by day, it scuttles along and seeks another shelter, rarely taking to wing. It is attracted to light at night to some extent.

Little is known in India regarding any parasites or other natural enemies of this insect. *Microbracon* sp. and a Bethylid have been reared and at Surat a Braconid was reared and is figured in *Indian Insect Pests* under the name of *Urogaster depressariæ*. In Egypt, Willcocks has given, on pages 233–269 of his monograph (9), a list of the parasites met with, and in Hawaii Swezey has also listed the parasites of this species (*Proc. Hawaii Ent. Soc.*, III, 101–109; 1915). Busck has also published notes on *Parasierola emigrata*, Rohwer (*Insec. Inscit. Menstr.*, V, 3-5; 1917) and Willcocks has recorded an Acarine parasite (*Bull. Soc. Ent. Egypt* 1913, 68–72; 1914), and this last, or a very similar species, also occurs in India.

GELECHIA TAMARICIELLA, Z.

Gelechia tamariciella, Zeller, Stett. Ent. Zeit., 1850, 153 (1); Stainton, Tin. S. Europe, pp. 80–81 (1869)(2); Rebel, Cat. Lep. Pal., ii, 151 (1901)(3).

Teleia tamariciella, Rebel, Iris, XXVI, 90 (1912) (4); Chretien, Ann. S. E. France, 1916, pp. 473–474 (May 1917) (5).

Originally described from Tuscany (1), this species is also recorded from Spain (2), Southern France (3), North Africa, Syria (4), and Egypt (5). In India it appears to be widely distributed throughout the Plains and probably occurs wherever *Tamarix* grows. We have it from Peshawar, Chapra, Pusa and Basra.

In Egypt the larva has been found on *Tamarix*(4) and has been described by P. Chretien(5) and at Pusa it occurs commonly on *Tamarix gallica* and has been collected in February, May and December. The larva feeds on the dry twigs, binding three or four twigs together and residing in the case so formed. It is about 10-11 mm. long and 1·5 mm. broad, tapering posteriorly, reddish-brown; head pale brown, posteriorly irrorated with darker dots, and covered with scattered fine grey hairs; prothorax pale brown; mesothorax deep brown; legs black, brownish apically; warts I and II black, emitting three or four short black hairs; lateral tubercles similar but larger, an ill-defined dark dorsal line bordered by minute white dots; five pairs of prolegs. In another larva the head and thorax were described as green, other segments dull brown, green ventrally.

The larva seldom emerges from its case which it sometimes carries about with it, retreating inside when disturbed. It is therefore easily overlooked. In captivity pupation took place inside a flimsy cocoon formed by fastening three or four twigs together and attaching them to the bottom of the cage. The pupal period is about eight days in May and fifteen days in February. (Pusa Insectary Cage-slips 644, 1052, 1171.)

STEGASTA VARIANA, MEYR.

Stegasta variana, Meyr., Proc. Linn. Soc. N. S. W., XXIX, 314 (1904)(1), B. J., XVII, 140 (1906)(2), Ann. Transvaal Mus., II, 12 (1909)(3), *l. c.*, III, 65 (1911)(4), Entom. Mitteil. Suppl., III, p. 50 (1914)(5).

Originally described from Eastern Australia(1) and afterwards from Ceylon (2), South Africa(3, 4) and Formosa (5), this species is widely distributed in India and Ceylon, and we have it from Peradeniya, Coimbatore, Bassein Fort (Bombay), Hoshangabad, Katni (Central Provinces), Palamau, Cuttack, Pusa and Shillong. It has been reared at Pusa from larvæ found webbing, and sometimes rolling, leaves of *chakwar* (*Cassia tora*) and *chameli* (*Jasminum* sp.). The larva usually binds together two leaves, one above another, and lives in the shelter so formed, feeding on the epidermis and mesophyll substance, and leaving a thin layer of one epidermis.

The full-grown larva is 8 to 9 mm. long, cylindrical, slightly tapering posteriorly, segments distinct, green (becoming pink before pupation); head flattened, black, shiny, smaller than prothorax; prothorax smaller than mesothorax, wholly covered above by a black, shiny shield, ventrally black with a pinkish tinge; mesothorax black with a pinkish tinge or (in other specimens) reddish-brown; legs black; tubercles small, black, emitting short grey hairs; five pairs of equally developed prolegs.

Pupation takes place in a sort of cocoon formed by lining the larval shelter with a thin layer of silk. The pupa is about 4 to 4·5 mm. long, brown, anal segment with thin cremastral hooks which hold the pupa-case within the cocoon on emergence of the moth. The pupal period is five or six days in October. (Pusa Insectary Cage-slips 608, 803.)

ONEBALA BLANDIELLA, WLK.

Onebala blandiella, Wlk., XXIX, 792 (1); Wlsm., in Swinh., Cat. Lep. Het. Oxf. Mus., II, 545 (1900) (2); Meyr., T. E. S., 1894, 16 (3).

"Larva greenish, naked, about an inch long. Leaf-roller on a common species of dead-nettle at Ootacamund. Imago emerges in February(2)."

Also recorded from Ceylon(1) and Burma (Mone)(3).

ZALITHIA DILUTICORNIS, WLSM.

Cryptolechia diluticornis, Wlsm. in Moore's Lep. Ceylon, III, 519, t. 209, f. 7 (1887)(1).

Pachnistis diluticornis, Meyr., B. J., XX, 707 (1911)(2).

We have this from Surat (where it was reared from a larva on dry cotton-stalks), Chapra, and Pusa.

This species has been reared at Pusa from larvæ found on 25th January 1906 under *gular* (*Ficus glomerata*) bark, and from larvæ found on 27th January 1917 amongst dry fallen leaves. The larva feeds on dry leaves. It is about 15 mm. long, cylindrical, greyish, clothed with black hairs so densely that the segments are not distinguishable and the larva looks like a mass of hairs; many hairs are longer and rise above the dense mass, these longer hairs being greyish; head black, shiny; five pairs of equally developed greyish prolegs; legs black. Pupation takes place, within the cavity formed by dead dry leaves which have rolled up to some extent, in a blackish cocoon in which all the hairs from the body of the larva have been knitted. The moths emerge in March after a pupal period of four or five weeks. (Pusa Insectary Cage-slips 290, 1529.)

THYRSOSTOMA GLAUCITIS, MEYR.

Thyrsostoma glaucitis, Meyr., B. J., XVII, 736 (1907)(1), Exot. Micr., II, 120 (1918)(2).

Described from Peradeniya where it was reared "from mango leaf"(1).

Besides Ceylon, received from Coorg, Kanara and Assam; attached to mango, apparently common(2).

DACTYLETHRA CANDIDA, STT.

Anarsia candida, Stainton, T. E. S. (n. s.) V, 114-115 (1859)(1).
Dactylethra candida, Meyr., B. J., XXII, 167 (1913)(2).

Originally described from Calcutta(1). Doubtless widely distributed in the Plains. We have it from Adoni, in the Bellary District, where it was reared from a larva making galls in stems of *Tephrosia purpurea* in August 1912, from Koilpatti where the larva was found causing galls on tender shoots of a wild indigo in August 1907, and from Manganallur, where it was bred in September 1917 from wild indigo.

LECITHOCERA CRYPSILYCHNA, MEYR.

Brachmia crypsilychna, Meyr., B. J., XXII, 773-774 (1914)(1).
Lecithocera crypsilycha, Meyr., Exot. Micr., II, 103 (1918)(2).

Described from Bassein Fort, Bombay. The larva was found between spun leaves of *Ipomœa arvensis*(1).

LECITHOCERA EFFERA, MEYR.

Lecithocera effera, Meyr., Exot. Micr., II, 104 (1918)(1).

Bred at Coimbatore from larva feeding on leaves of sweet-potato (*Ipomœa batatas*) in September. Pupa-case clothed with scattered erect hairs, a curious

feature ; four segments free. Also recorded from Surat(1). It has also been reared at Coimbatore on 9th June 1913 from a pupa found on horse-radish.

BRACHMIA ENGRAPTA, MEYR.

Brachmia engrapta, Meyr., Exot. Micr., II, 114 (1918)(1).

Bred at Lahore in July from larva on sweet-potato (*Ipomœa batatas*). Also found at Coimbatore in October(1).

BRACHMIA AROTRÆA, MEYR.

Cladodes arotræa, Meyr., T. E. S., 1894, 15(1).

Brachmia arotræa, Meyr., B. J., XX, 723 (1911)(2).

This species was originally described from Koni (Burma)(1) and has since been recorded from Ceylon(2), the Khasi Hills(2) and Southern India(2). It seems to be widely distributed throughout India, Burma and Ceylon.

It " has been bred in small numbers from larvæ on rice leaves at Pusa and Katni (Central Provinces). We have it also from Cuttack and Palamau and it occurs in Burma and Ceylon. It is therefore likely to be found on paddy in most districts but is not a pest, so far as we know." (Proc. Sec. E. M., p. 164.) It has also been reared at Samalkota on paddy.

A larva was found at Pusa on 17th September 1907, rolling a rice leaf to form a shelter inside which it lives, feeding on the leaf and filling the roll with excrement. The full-grown larva is about 9 mm. long, cylindrical, tapering posteriorly, light green ; head shiny black, labrum reddish-brown ; prothorax with a shiny, black shield ; mesothorax with a black subdorsal dot ; metathorax with a thick black shield ; legs black, shiny ; abdominal segments with a light green dorsal stripe and several more or less interrupted lateral stripes ; primary hairs few, dark ; five pairs of dull white prolegs. Pupation takes place within the larval shelter. The pupa is 5 mm. long, cylindrical, tapering posteriorly, brown. The pupal period is about six days. (Pusa Insectary Cage-slip 602.)

BRACHMIA IDIASTIS, MEYR.

Brachmia idiastis, Meyr., Exot. Micr., I, 577 (June 1916)(1).

Described from Pusa, where it was bred in June from larva feeding on *Panicum* sp.(1).

Larvæ were found at Pusa on 5th April 1910 and 25th May 1914, rolling leaves of *Panicum* sp. The larva rolls a leaf longitudinally by folding the margins together, living inside the shelter so formed and eating the epidermis and also the mesophyll substance of the leaf, leaving entire one epidermal layer which turns yellow.

The larva is about 10 mm. long when extended and about 1 mm. broad, segments distinct, light yellow; head black, shiny; prothorax with a shiny black shield divided medially by a narrow white line; mesothorax dark dorsally; metathorax and first abdominal segment wholly blackish; second and following abdominal segments with a broad black submedian stripe, from which on the anterior part of each segment arises a narrower black marking which runs obliquely downwards to the posterior part of the segment; hairs short, black, scattered; legs black, shiny; five pairs of equally developed yellow prolegs.

Pupation takes place in a cocoon formed by twisting a leaf around twice to form a tube which is lined with a thin layer of silk. The pupal period is about five days. (Pusa Insectary Cage-slips 832, 1063.)

BRACHMIA INSULSA, MEYR.

Brachmia insulsa, Meyr., B. J., XXII, 774 (1914)(1).

This species was originally described from Pusa and we have it from Peshawar, Abbottabad, Pusa and Belgaum. It appears to be common throughout the Plains of India. At Pusa the moths are abundant in May and June and occur in smaller numbers in February and March.

It has been reared at Pusa from a larva found on 1st February 1910 on potato. The larva rolls a leaf or binds two leaves together with silk threads, living in the shelter so formed and nibbling small holes in the leaf When full-grown the larva is about 14 mm. long, cylindrical, pink with a dark tinge; head shiny, dark brown, posteriorly almost black; prothoracic shield large, prominent, black, shiny; thoracic segments dark; segments with scattered hairs; five pairs of equally developed prolegs. Pupation takes place in a cocoon formed by lining the larval shelter with white silk. The pupa is about 6 mm. long, brown, the anal extremity prolonged into a flattened, pointed process bearing two long thin stiff divergent hairs. (Pusa Insectary Cage-slip 827.)

BRACHMIA XEROPHAGA, MEYR. (PLATE XX, FIG. 1.)

Brachmia xerophaga, Meyr., Ent. Mo. Mag. 1914, 219–220(1).

The larva, dark red in colour, occurs in nests of *Stegodyphus sarasinorum*, and doubtless feeds on the fragments of the numerous insects caught in the webs; the pupa is also found in the nest, as is the moth itself. The latter may be seen resting on the outside of the web-nest or running freely into the galleries leading to its interior(1).

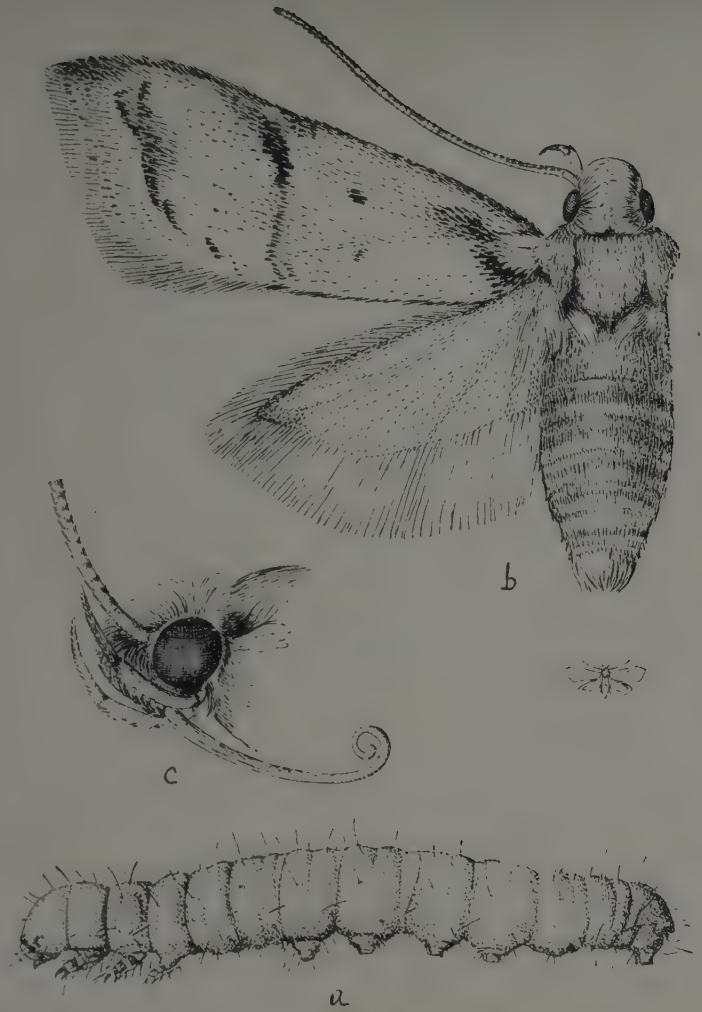

Fig. 1. *Brachmia xerophaga*:—*a*, Larva (x 13) ; *b*, moth, natural size and magnified (x 13) ; *c*, head of moth, from side, magnified (x 22).

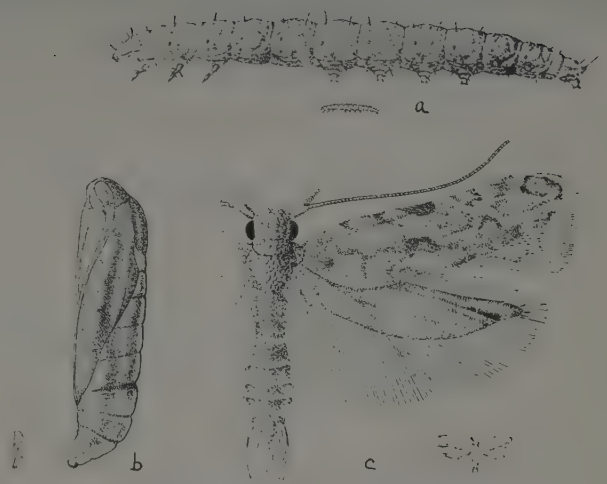

Fig. 2. *Anarsia ephippias*:—*a*, Larva ; *b*, pupa ; *c*, moth, natural sizes and magnified (x 8).

Fig. 3. *Anarsia melanoplecta*:—Moth, natural size and magnified, with a more highly magnified side-view of the head.

PLATE XX.

Described from specimens from Guindy, Madras(1). Also found by Dr. Gravely at Puri, Orissa.

HELCYSTOGRAMMA HIBISCI, STT.

Gelechia ? hibisci, Stainton, T. E. S. (n. s.) V, 117(1).
Gelechia ? hibisci, Snell., Tijd. voor Ent., XLVI, 43–44, t. 5, ff. 3, 4(2).
Strobisia hibisci, Meyr., B. J., XX, 732 (1911)(3).
Helcystogramma hibisci, Meyr., T. E. S., 1914, 270(4).
Helcystogramma obseratella, Zeller, H. S. E. R., XIII, 371–373, t. 5, f. 127, (1877)(5).

Larva small, green, with the head black; it feeds on the tops of the yellow *Hibiscus*(1); on *Hibiscus*(1).

Widely distributed throughout India and Ceylon. We have it from Pusa, Nagpur, Pollibetta (Coorg) and Shillong.

Outside of India it has been recorded from Java by Snellen(2), and "probably from Cuba" by Zeller(5), this latter record being perhaps in error.

The larva was found at Pusa on 17th September 1907, rolling leaves of *Hibiscus esculentus*. The larva was described as about 12 mm. long, cylindrical, slightly tapering posteriorly, yellowish-green; head shiny black, with scattered minute whitish hairs, labrum greyish-red, antennæ prominent; prothoracic shield black, shiny; body segments distinct; warts small, dark, emitting a short whitish hair, five pairs of prolegs.

Pupation takes place in a cocoon spun amongst loose leaves. The pupa is brown, cylindrical, broad apically, tapering posteriorly, dorsal and lateral areas with short hairs; anal segment with four cremastral hooks which are entangled in the silken threads of the cocoon and which retain the pupa-case inside the pupal shelter on emergence of the moth. The pupal period is five or six days. (Pusa Insectary Cage-slip 601.)

AUTOSTICHA AUTHÆMA, MEYR.

Epicœnia authœma, Meyr., B. J., XVII, 141 (1906)(1).

Described from Peradeniya, where the larva, in a heliciform case, feeds on moss-covered rocks(1).

This is a Ceylonese species, not yet found in India.

AUTOSTICHA CHERNETIS, MEYR.

Epicœnia chernetis, Meyr., B. J., XVII, 141 (1906)(1).
Autosticha chernetis, Meyr., B. J., XVII, 459(2).

Recorded from Peradeniya, where the larva lives in galleries on moss-covered rocks(1).

AUTOSTICHA EXEMPLARIS, MEYR.

Autosticha exemplaris, Meyr., Exot. Micr., I, 586–587 (June 1916)(1).

Described from Coimbatore, where it was bred in October, together with various other Lepidoptera, from refuse in the fork of a tamarind-tree. It is doubtful whether the present species is a refuse-feeder, it may only have entered for pupation or been carried in with leaves; the known Ceylon larvæ of this genus are lichen-feeders; on the other hand, the Hawaiian species, *pelodes*, is a refuse-feeder and it is therefore possible that *exemplaris* may be one also.

One of the specimens reared at Coimbatore from this lot was a teratological example, with two small duplicate hindwings on the right side. This specimen has been placed in the British Museum (Natural History) Collection.

AUTOSTICHA PROTYPA, MEYR.

Autosticha protypa, Meyr., B. J., XVIII, 457–458 (1908)(1).

Described from Ceylon (Maskeliya, Maturatta, and Peradeniya), where the larva lives in galleries on lichen on rocks(1).

PARASPISTES PALPIGERA, WLSM.

Gelechia palpigera, Wlsm., T. E. S. 1891, 94, t. 4, f. 31 (1891)(1).

Paraspistes ioloncha, Meyr., B. J., XVI, 600 (1905)(2), Tr. Linn. Soc. (2) XIV, 274 (1911)(3).

Liptia crotalariella, Busck, Bull. Dept. Trinidad, IX, 243 (1910)(4).

Paraspistes palpigera, Busck, Proc. U. S. Nat. Mus., XLVII, 10-11 (Apl. 1914)(5).

Originally described from Delagoa Bay, East Africa(1), this species has been reared at Coimbatore in August and September 1916, in some numbers in indigo pods and also from larvæ in pods of *Cassia corymbosa* and *Cassia flora*. At Manganallur it was also reared from wild indigo. We have this species from Puttalam (Ceylon), Pollibetta (Coorg), Coimbatore, Manganallur, and Bhamo (Burma), and it has also been recorded from Peradeniya(2), where it was reared in July from pods of *Crotalaria*(2), from the Seychelles(3), from the British West Indies(4, 5), where the larva was also found in pods of *Crotalaria*(4), and from the Bahamas(5), and Panama(5).

HYPELICTIS ALBISCRIPTA, MEYR.

Hypelictis albiscripta, Meyr., B. J., XXII, 773 (1914)(1).

Reared in North Kanara from pupa found between closely-spun leaves of *Salix*(1).

DICHOMERIS IANTHES.

STROBISIA AMETHYSTIAS, MEYR.

Zalithia amethystias, Meyr., B. J., XVII, 110 (1906)(1).

Strobisia amethystias, Meyr., B. J., XX. 726(2), Exot. Micr., II, 144 (1918)(3).

Originally described from Peradeniya(1).

" Bred from a larva feeding in fungus-bed of Termites' nest (*Green*) "(3).

TRICHOTAPHE GEOCHROTA, MEYR.

Trichotaphe geochrota, Meyr., B. J., XXII, 775 (1914)(1).

This species was reared from a larva found on leaves of an unidentified plant at Bassein Fort (Bombay) on 1st October 1909. The larva was described as about 8 mm. long, tapering towards either extremity, creamy white ; head yellowish ; prothorax with a minute reddish dot on side just below head, a yellowish dorsal band, and below this band two yellowish dots on side, mesothoracic and following segments with a light chocolate-coloured dorsal band nearly complete and straight on meso- and metathorax, but slightly curved on abdominal segments ; these bands on abdominal segments (except on anal segment) are not complete, being interrupted dorsally, and bear two black dots on the anterior side; legs and prolegs normal, anal prolegs rather blunt, and prolegs directed backwards. Pupation took place under shelter of a leaf fastened to the side of the rearing cage. The pupa was slightly over 5 mm. long, yellowish brown. The pupal period was six days. (A. Mujtaba's Cage-slip 63.)

EXPLANATION OF PLATE XXI.

DICHOMERIS IANTHES.

Figs. 1. An affected Java-Natal indigo plant

2. Egg, enlarged.

3. Caterpillar, enlarged.

4. Pupa, enlarged.

5. } Moth in flying and resting attitudes.

6. }

(The hair-lines show the natural sizes.)

DICHOMERIS IANTHES, MEYR. (PLATE XXI.)

Hypsolophus ianthes, Meyr., T. E. S., 1887, 273–274(1).

Ypsolophus ochrophanes, Meyr., B. J., XVII, 981 (1907) (2) ; Lefroy, Ind. Ins. Life, pp. 533–534 (1909)(3), Agricl. Jl. Ind., V, 161–162(3*a*).

Ypsolophus ianthes, Meyr., Rec. Ind. Mus., V, 223(4). Tr. Linn. Soc. (2) XIV, 275 (1911)(5).

Dichomeris ianthes, Meyr., B. J., XXII, 172 (1913) (6). Entom. Mitteil. Suppl., III, p. 51 (1914)(7) ; Fletcher, S. Ind. Ins., pp. 456–457, f. 332 (1914)(8) ; Rutherford, Tropl. Agric., XLIII (Sept. 1914) (9) ; Proc. Second Entl. Meeting, pp. 61, 80 (tab.), 207 (1917)(10).

Widely distributed in India and Ceylon, extending to Reunion (1, 5) and the Seychelles(5) and Formosa(7). Apparently not yet recorded from Burma. We have specimens from Champaran, Gondra, Muhammadpur, Pusa, Dalsing Serai, Bassein Fort, Palur and Mercara.

EXPLANATION OF PLATE XXI.

ORNITHOPTERA ANTHEUS.

Fig. 1. An affected Java Natal indigo plant.
" 2. Egg, enlarged.
" 3. Caterpillar, enlarged.
" 4. Pupa, enlarged.
" 5. Moth in flying and resting attitudes.
" 6. (The hair-lines show the natural sizes.)

STROBISIA AMETHYSTIAS, MEYR.

Zalithia amethystias, Meyr., B. J., XVII, 140 (1906)(1).

Strobisia amethystias, Meyr., B. J., XX. 726(2), Exot. Micr., II, 144 (1918)(3).

Originally described from Peradeniya(1).

"Bred from a larva feeding in fungus-bed of Termites' nest (*Green*)"(3).

TRICHOTAPHE GEOCHROTA, MEYR.

Trichotaphe geochrota, Meyr., B. J., XXII, 775 (1914)(1).

This species was reared from a larva found on leaves of an unidentified plant at Bassein Fort (Bombay) on 1st October 1909. The larva was described as about 8 mm. long, tapering towards either extremity, creamy white; head yellowish; prothorax with a minute reddish dot on side just below head, a yellowish dorsal band, and below this band two yellowish dots on side, mesothoracic and following segments with a light chocolate-coloured dorsal band nearly complete and straight on mesothorax and metathorax but slightly curved on abdominal segments; these bands on abdominal segments (except on anal segment) are not complete, being interrupted dorsally, and bear two black dots on their ends; legs pointed, creamy; five pairs of prolegs, rather blunt, anal prolegs directed slightly posteriorly. Pupation took place under shelter of a leaf fastened to the bottom of the cage. The pupa was slightly over 5 mm. long, yellowish-brown. The pupal period was six days. (A. Mujtaba's Cage-slip 63.)

DICHOMERIS IANTHES, MEYR. (PLATE XXI.)

Hypsolophus ianthes, Meyr., T. E. S., 1887, 273–274(1).

Ypsolophus ochrophanes, Meyr., B. J., XVII, 981 (1907) (2); Lefroy, Ind. Ins. Life, pp. 533–534 (1909)(3), Agricl. Jl. Ind., V, 161–162(3*a*).

Ypsolophus ianthes, Meyr., Rec. Ind. Mus., V, 223(4), Tr. Linn. Soc. (2) XIV, 275 (1911)(5).

Dichomeris ianthes, Meyr., B. J., XXII, 172 (1913) (6), Entom. Mitteil. Suppl., III, p. 51 (1914)(7); Fletcher, S. Ind. Ins., pp. 456–457, f. 332 (1914)(8); Rutherford, Tropl. Agric., XLIII (Sept. 1914) (9); Proc. Second Entl. Meeting, pp. 61, 80 (tab.), 207 (1917)(10).

Widely distributed in India and Ceylon, extending to Reunion (1, 5) and the Seychelles(5) and Formosa(7). Apparently not yet recorded from Burma. We have specimens from Champaran, Gondra, Muhammadpur, Pusa, Dalsing Serai, Bassein Fort, Palur and Mercara.

Larva described by Lefroy[3] and Fletcher[8]. Feeds on *Medicago*[5], *Cyamopsis*[5, 10], and is a pest of indigo[3, 8, 10] and lucerne[8, 9, 10].

This species is quite of minor importance as a rule but in 1909 it appeared in the Champaran District as a serious pest of Java indigo and did considerable damage, as is instanced in the following report :—" The caterpillars seem to have made a pretty clean sweep of the field attacked ; there are very few plants unattacked, practically all have their leaves reduced to a dirty brown powder and many are merely bare sticks," young plants only a few inches high being attacked in August, September and October, the caterpillars webbing up the leaves at the top of the young shoot, feeding on them, and checking the growth of the plant.

In confinement, a female moth laid 37 eggs between 8th and 10th October 1909. The egg is elongate-oval, cylindrical with rounded ends, about 0·5 mm. long, light green when laid, gradually becoming yellowish, and pinkish just before hatching. The eggs are usually laid in the groove of the petioles of the leaves and nearly always on leaves near the top of the plant. On *guar* eggs were deposited alongside the raised veins on the under-surface of the leaf. The eggs may be deposited singly or as many as six in one place ; when several are laid, they usually lie lengthwise in the groove, touching each other. The larva hatches out after about four days, and does not eat the egg-shell.

The newly-hatched larva is about 0·75 mm. long, cylindrical, light yellow with a greenish tinge ; head larger than other segments, shiny, dark red brown ; prothoracic shield shiny, reddish-brown ; primary hairs comparatively long ; five pairs of equally developed prolegs.

The full-grown larva is about 7 mm. long and slightly more than 1 mm. broad, green ; head shiny black ; prothorax black, with a large shiny black shield ; prothoracic legs black, mesothoracic and metathoracic legs green ; minute hairs scattered over segments ; five pairs of equally developed prolegs.

On hatching from the egg the larvæ usually crawl onto the tender top-leaves, fold a leaf, live hidden inside it and so feed. They bite the leaf usually from the edge and go on eating until little is left to afford a shelter, then they leave the leaf and go to another. The leaf thus eaten withers and dries up. As they grow larger they bind two or three, or more, leaves together, the leaves retaining their flat shape. The larval life is about fifteen days.

Pupation takes place either between two leaves fastened together or in a rolled leaf or in the larval shelter of top-leaves bound together, the interior of the shelter being lined with a thin layer of silken fibre. The pupa is about 5 mm. long, cylindrical, tapering to a point posteriorly, brown ; the anal extremity prolonged into a process from the apex as well as from the base of

which arise many stiff brown circinate hairs which are entangled in the fibres of the cocoon. The pupal period is about six days. The whole life-cycle is thus about 25 days. (Pusa Insectary Cage-slip 796.)

DICHOMERIS EVIDANTIS, MEYR.

Ypsolophus evidantis, Meyr., B. J., XVII, 981 (1907)(1).
Dichomeris evidantis, Meyr., B. J., XXII, 172 (1913)(2).

Described from Pusa, in April and May. The larva rolls a green leaf of *Dalbergia sissu* or more commonly fastens together two leaves, living inside the shelter thus formed and nibbling the epidermis or gnawing holes in the leaves. The larva is about 24 mm. long and 2 mm. broad, slightly flattened, pale greenish yellow, the deep green dorsal vessel showing as a stripe; head flattened, yellow, speckled with brownish; prothoracic shield large, pale yellow; two faint interrupted submedian stripes and a similar subspiracular stripe; spiracles round, rimmed with black; primary hairs rather long; five pairs of equally developed prolegs. Pupation takes place in a white silken cocoon formed inside the larval shelter. Pupa brown, anal segment rather prolonged and armed with eight circinate hairs, which are entangled in the fibres of the cocoon, inside which the empty pupa-case remains on emergence of the moth. (Pusa Insectary Cage-slips 680, 896, 995.)

ANARSIA ACERATA, MEYR.

Anarsia acerata, Meyr., B. J., XXII, 169 (1913)(1).

This species, originally described from North Coorg(1), was reared at Saidapet, Madras, on 10th October 1906, from a larva found on *Cajanus indicus*.

ANARSIA ALTERCATA, MEYR.

Anarsia altercata, Meyr., Exot. Micr., II, 148 (1918)(1).

" Bred at Pusa in July from pupa in rolled leaf of *Sesbania*"(1).

ANARSIA DIDYMOPA, MEYR.

Anarsia didymopa Meyr., Exot. Micr., I, 583 (1916)(1).

This was reared at Pusa on 23rd July 1908 from a pupa found on 18th July attached to the back of a leaf of *bagnahi* (*Capparis horrida*) and covered with another piece of leaf. The pupa was a little more than 4 mm. long, slightly tapering posteriorly, segments distinct, reddish-brown, wings reddish-yellow. (A. Mujtaba's Cage-slip 46.)

ANARSIA EPHIPPIAS, MEYR. (PLATE XX, FIG. 2.)

Anarsia ephippias, Meyr., Ent. Mo. Mag., XLIV, 197 (1908)(1) ; Lefroy, Ind. Ins. Life, p. 534, t. 56 (1909)(2) ; Proc. Second Entl. Meeting, pp. 51, 53, 91 (1917)(3) ; Fletcher, Ann. Rept. Impl. Entom., 1917–18, pp. 103–104 (1918)(4).

This species is widely distributed in the Plains of India. In Bihar it has been found at Pusa, Chapra, Paddankaii and Gondra ; at Paddankaii (Champaran) and Gondra the larva occurred on indigo and at Pusa it has been found on groundnut, soybean, *moth*, *urid* and *mung*. In Southern India it has been noted at Saidapet (larva on *Cajanus indicus*), and at Virajpet, in South Coorg (larva on flowers of *Acacia* sp.). In the Punjab Madan Mohan Lal has recorded it as a fairly bad pest of groundnut(3), but I have seen no specimens from the Punjab. At Mandalay also K. D. Shroff has found a small larva, perhaps of this species, boring top-shoots of *urid*(3). At Pusa it is usually a minor pest of the crops mentioned above, the larva rolling the top-shoots and boring into the flower-buds, flowers and pods and eating the seeds.

It may be noted that many closely-allied species of *Anarsia* occur in India and that many of these are attached to leguminous crops, so that careful discrimination of the species is necessary.

The larva ties together with silk the top-leaves, flower-buds or flowers on which it is feeding. When full-grown it is about 10 mm. long and about 1·75 mm. broad across mid-body, rather flattened, segments distinct, dark red-brown, deep pinkish-brown, or dark purple ; head rather flattened, yellow-brown, shiny ; prothoracic shield large, yellow-brown ; primary hairs short, arising from slightly raised tubercles ; legs black ; five pairs of equally developed prolegs.

Pupation takes place amongst the flowers or inside a rolled leaf. The pupa is about 5 mm. long, red-brown, anal extremity with a number of short circinate hairs on ventral surface and a few much longer hairs on apex. The pupal period is about five days in July and nine or ten days in November. (Pusa Insectary Cage-slips 72, 918, 1637.)

ANARSIA EPOTIAS, MEYR.

Anarsia epotias, Meyr., Exot. Micr., I, 583 (June 1916)(1).

Described from Pusa, where it has been reared from larvæ found in *Tamarix* twigs on 10th May 1914.

The larva webs several green twigs together lengthwise and lives hidden and feeds from within. The larva is about 12 mm. long, cylindrical, pale

greenish-yellow; head dark brown, shiny; prothorax with dorsal dark brown shiny shield, ventrally dark brown; tubercles on segments minute black points emitting short grey hairs; five pairs of prolegs. Pupation takes place in a white silken cocoon formed inside the larval shelter. Moths have been bred in March and May. (Pusa Insectary Cage-slips 1054, 1180.)

ANARSIA EXALLACTA, MEYR, MS.

This species was reared at Pusa on 7th October 1912 from at larva found on top leaves of *arhar* (*Cajanus indicus*).

ANARSIA IDIOPTILA, MEYR.

Anarsia idioptila, Meyr., Exot. Micr., I, 582–583 (June 1916)(1).

Described from Pusa, where it was taken from *Cassia fistula* in June(1).

This species was reared from a larva found at Pusa on 8th June 1913, folding or binding together several leaves of *Casssia fistula*, living hidden and feeding on the leaves from within its shelter. The larva is about 7 mm. long, flattened, light greenish-yellow with a broad brown subdorsal stripe; head flattened, yellowish brown; thoracic segments blackish; five pairs of prolegs. Pupation takes place within the larval shelter, the cremastral hooks of the pupa being fastened into a thin silken lining attached to one leaf. The pupa is about 4·5 mm. long and about 1·5 mm. broad across thoracic region, cylindrical, tapering to a point anally, dark brown, shiny. The pupal period is about five days in June. (Pusa Insectary Cage-slip 996.)

ANARSIA MELANOPLECTA, MEYR. (PLATE XX, FIG. 3.)

Anarsia melanoplecta, Meyr., B. J., XXII, 774 (1914)(1); Fletcher, Entl. Note 78 (1916)(2); Proc. Second Entl. Meeting, p. 221 (1917)(3).

Larva boring in shoots of mango (*Mangifera indica*) in May at Pusa.

This species is probably widely distributed, but overlooked. We have it from Pusa and Nagpur. At Pusa it has been found boring mango buds and twigs and feeding on mango inflorescence and at Nagpur it has been reared from mango flowers.

The larva has been described as "about 8 mm. long by 1 mm. in breadth; cylindrical, the segments well defined, in colour yellow with a pinkish tinge, the anal segment darker. The head and prothorax slightly smaller than the metathorax which is the broadest part of the body. The head is shining black, the prothorax dark grey with a prominent black shiny shield divided medially by a fine line. Five pairs of equally developed prolegs are present." The above larva was found at Pusa on 19th February 1912, boring the terminal shoot of a tender twig of mango.

The foregoing description agrees substantially with a description of another larva found at Pusa on 2nd May 1906, boring into a mango twig. The larva bores into the twig from the tip until it reaches a limit of the new year's growth, and there it makes a silken lining to the chamber it has excavated and also provides an opening for the emergence of the imago. (Y. Ramachandra Rao's Cage-slip 27.)

ANARSIA OMOPTILA, MEYR.

Anarsia omoptila, Meyr., Exot. Micr., II, 147 (1918)(1).

"Bred at Coimbatore in October from larvæ feeding between folded leaves of *Cajanus indicus*"(1).

ANARSIA SAGITTARIA, MEYR.

Anarsia sagittaria, Meyr., B. J., XXII, 774–775 (1914)(1).

Described from Pusa(1), where it has been reared from larvæ boring top-shoots of *ber* (*Zizyphus jujuba*) in August 1907 and June 1908, but no description of the early stages seems to have been made.

ANARSIA SAGMATICA, MEYR.

Anarsia sagmatica, Meyr., Exot. Micr., I, 582 (1916)(1).

This species has been reared at Pusa from a larva found on 16th February 1914, rolling the apical part of a *Loranthus* leaf transversely and fastening it into a cylindrical fold with white silk. The larva was living within this fold and nibbling the leaf from within its shelter. The larva was about 8 mm. long and a little more than 1 mm. broad across mid-body, slightly flattened, slightly tapering towards either extremity, uniform coppery-brown, the thoracic region darker, head shiny yellow-brown; segments not clearly marked, skin soft and smooth, small scattered hairs arising from minute papillæ; legs dull black; five pairs of equally developed prolegs. Pupation took place in a cocoon formed by lining the larval shelter with white silk. The larva pupated on 21st February, and the moth emerged on 7th March. (Pusa Insectary Cage-slip 1029.)

ANARSIA VERUTA, MEYR.

Anarsia veruta, Meyr., Exot. Micr., II, 148 (1918)(1).

"Bred at Pusa in February from pupa on *Inga dulcis* (Leguminosæ)"(1).

CHELARIA PHACELOTA, MEYR.

Chelaria phacelota, Meyr., B. J., XXII, 166 (1913)(1), Exot. Micr., I, 279 (1914)(2).

Recorded from Peradeniya(1, 2), where it was bred in July from Psyllid galls on *Mallotus philippinensis*(2).

CHELARIA RHICNOTA, MEYR.

Chelaria rhicnota, Meyr., Exot. Micr., I, 580–581 (June 1916)(1).

Described from the Shevaroy Hills and from Chittur, Madras Presidency(1).

Bred in February from larva found feeding on flowers of *Mangifera indica* at Chittur; the pupa with five abdominal segments fixed(1).

CHELARIA SCOPULOSA, MEYR.

Chelaria scopulosa, Meyr., B. J., XXII, 165–166 (1913)(1), *l. c.*, 774 (1914)(2).

Described from Karwar, where the larva was found burrowing in shoots of *Careya arborea*, showing some excrement on opening of hole(1).

CHELARIA SPATHOTA, MEYR.

Chelaria spathota, Meyr., B. J., XXII, 165 (1913)(1); Fletcher, Entl. Note 82 (1916)(2), Proc. Second Entl. Meeting, p. 219 (1917)(3).

Described from the Khasis and Konkan(1). It was reared at Pusa in December 1909 from a larva found eating mango leaves. It has also been reared from a larva found on tender mango leaves at Koilpatti, Madras Presidency in November 1909(2). No description of the early stages seems to have been made.

ÆCIA ŒCOPHILA, STDGR.

Macroceras œcophila, Stdgr., Stett. Ent. Zeit. 1876, 150(1).
Æcia maculata, Wlsm., P. Z. S., 1897, 11–112(2), Fauna Hawaii, pp. 649-650(3).
Æcia œcophila, Meyr., T. E. S., 1915, 201(4).

Recorded from Sicily(1), West Indies(2), Brazil(2), Peru(4), Hawaii(3) and India(4). We have specimens from Pusa and Coimbatore. The moth occurs on the walls of houses and the larva is probably a domestic rubbish-feeder. We have it from Pusa ("on bee blanket"), Coimbatore ("on a wall"), and Belgaum.